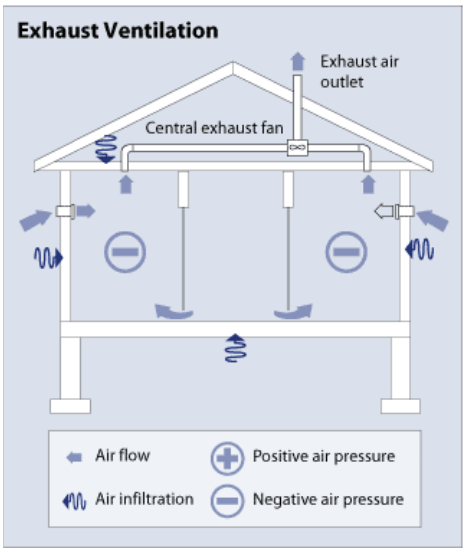
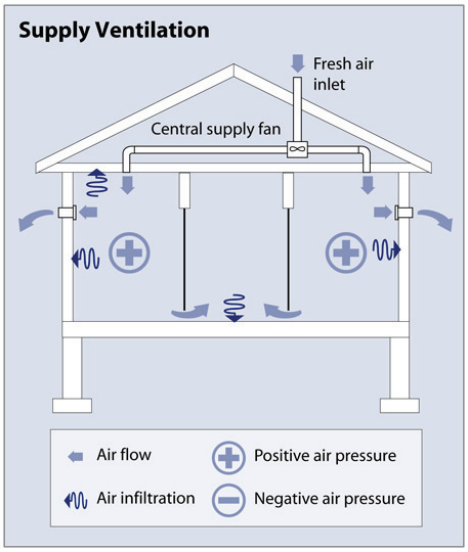
Loudoun County Green Home Program

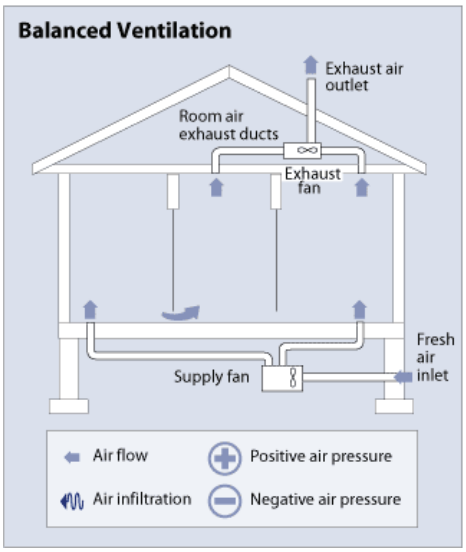
Ventilation - *for Building Professionals*



(1) Exhaust Ventilation Diagram



(2) Supply Ventilation Diagram



(3) Balanced Ventilation Diagram

Myth: *Homes need to breath.*

Fact: *Older homes typically rely on infiltration for ventilation. Typically these homes do not experience the same moisture problems often found in newly constructed homes with inadequate ventilation since they are constantly being flushed. Although it appears infiltration positively impacts indoor air quality, this is not considered best practice as older homes consume more energy than their more tightly constructed counterparts and often have issues with maintaining thermal comfort. The mantra when building new homes should be, "build tight, ventilate right."*

This bulletin is for HVAC professionals, builders and remodelers. It will focus on the importance of properly designing ventilation, because ventilation as part of HVAC system design is often ignored in the single family construction industry.

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The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) defines ventilation as the process of supplying air to or removing air from a space for the purpose of controlling air contaminant levels, humidity, or temperature within the space. Traditional forced air distribution systems are designed as closed loop systems and do not exchange air outside the building envelop. Older homes have historically relied on air leakage through the building envelope to meet ventilation needs. Poor indoor air quality is a serious issue in today's housing stock as volatile organic compounds from finishes, furniture, cleaning products, cosmetics, and other household items contribute to the home's indoor air quality.

Fact: *"The average house today contains more chemicals than were found in a typical chemistry lab a century ago."*

Debra Lynn Dadd, **The Nontoxic Home**

New construction, with its emphasis on building tightness, needs to address controlled ventilation in order to avoid indoor air quality (IAQ) issues associated with contaminants and other pollutants.

Exhaust Ventilation

Exhaust ventilation is used to remove stale and/or humid air from the building and is the most widely utilized ventilation strategy in the mid-Atlantic. This approach generally relies on spot ventilation for exhaust while make-up air is provided though infiltration. These are intermittent systems controlled by the occupant that are either directly vented to the outside or attached to a single vent that is directed to the outside. Examples of exhaust ventilation include bathroom exhaust, clothes dryer exhaust and kitchen range exhaust.

Image 04: Installation of exhaust fan

Because this strategy pulls air out of the building and depressurizes the enclosure, it is important to have a back draft damper to keep outside air from being pulled in when fans are not operational.

Tip: *Exhaust ventilation should terminate to the outside and not to the attic. Supply air should be pulled in from areas free of contaminant sources such as dumpsters, parking areas, smoking areas or directly off roof tops.*

Supply Ventilation

A supply only system brings outside air into the structure and relies on natural exfiltration for the removal of stale air. This approach pressurizes the building and makes it difficult for pollutants to enter the conditioned space. Supply ventilation systems can be integrated into the return side of the HVAC plenum where outside air is filtered, conditioned and distributed throughout the home. This approach only provides ventilation when the HVAC system requires air. Continuous ventilation can be accomplished through the use of a thermostat. The thermostat can be programmed to allow the air handler fan to run continuously or intermittently through a timer function. The best strategy for continuous supply side ventilation utilizes a separate fan cycling controller

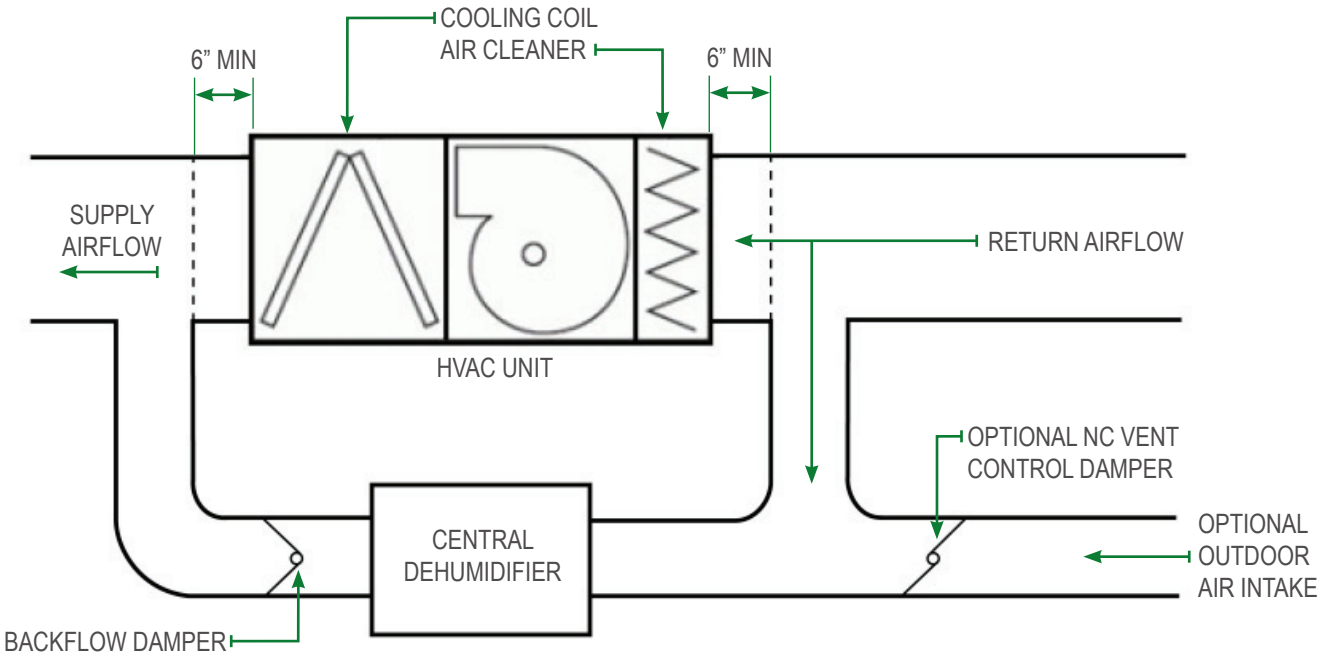

Image 05: Diagram of HVAC and dehumidifer

that circulates air with an electronically commutated motor that controls the air handler fan operation. If the outside air is not tempered and filtered it can have a negative effect on humidity control, indoor air quality and energy usage. All supply ventilation strategies should include a motorized outside air damper to minimize the introduction of outside air.

Balanced System

A balanced system is a combination of exhaust and supply where equal amounts of air are exchanged in the home. This system mechanically removes stale air from the residence while simultaneously bringing fresh air back into the living space. This strategy often results in a neutral pressure in the building. This balanced ventilation strategy can be achieved by using either an Energy Recovery Ventilator (ERV) or a Heat Recovery Ventilator (HRV) in which the exhaust air stream crosses with the supply airstream through the core of the appliance without mixing.

Both the ERV and HRV appliances have the ability to transfer the energy recovered from outgoing exhaust air into the incoming supply air. Because an ERV has the added benefit of transferring some moisture (from the incoming hot humid summer air or the outgoing heated humid air in the winter), ERV's are more suitable for our climate zone. Both ERV and HRV technologies are efficient and are designed for continuous operation if required.

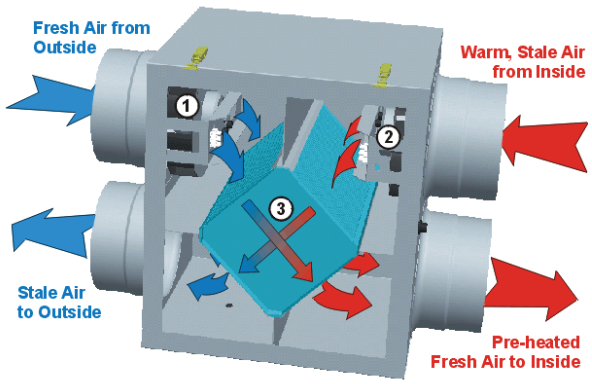

Image 06: Diagram of ERV

Image 07: Installation of ERV

However, these systems have limited dehumidification capabilities.The best strategy for dehumidification is a whole house dehumidifier which can integrate directly into a home's HVAC system. The stand alone dehumidifier operates year round and controls humidity by extracting moisture from the air. However, these are not considered stand alone ventilation strategies since they use a fan cycling controller and are independent from the air conditioning system.

How to Mechanically Ventilate

Whichever approach is used all ventilation systems should be designed in accordance with ASHRAE 62.2-2007 Ventilation Standard in order to ensure that acceptable air exchange rates are achieved. This standard is required in many states, by Energy Star for Homes, and many high performance green building programs.

ASHRAE recommends existing homes with an exchange rate of less than 0.35 Natural Air Change per Hour should have mechanical ventilation. For retrofit purposes, an ERV or HRV measures approximately 2'x 2' x 3', and will require a 110 volt electrical outlet as well as space for four 6" duct runs.

The following formula is used to determine how many cubic feet per minute (CFM) should be introduced into the home, where "A" equals conditioned floor area.

$$CFM = 0.01A + (\#\ of\ bedrooms + 1)7.5$$

The formula is designed to allow 7.5 CFM per person by assuming one person per bedroom and two people in the master bedroom plus 1 CFM per 100ft^2 of conditioned floor area.

For example a 2000 ft^2 home with three bedrooms would require 50 CFM of continuous ventilation:

$$CFM = 0.01x2000 + (4x7.5)=50\ CFM$$

Fact: *While opening doors and window are appropriate for certain times of the year, this strategy will not meet ventilation needs year round nor control air exchange rates.*

Image Sources

(1) http://www.energysavers.gov/
(2) http://www.energysavers.gov/
(3) http://www.energysavers.gov/
(4) Courtesy of EarthCraft Virginia
(5) http://www.dehumidifierexperts.com
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(7) Courtesy of EarthCraft Virginia

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